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Agricultural Marketing Service

EFFECTS ON OUTLOOK FORECASTS OF DIFFERENCES BETWEEN EARLY-SEASON AND FINAL ESTIMATES OF PRODUCTION AND PRICES FOR WHEAT, RYE, AND RICE[1]

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by

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A sounder basis for outlook work is provided by results of a research project undertaken to survey the way in which early-season estimates of production and prices for major commodities differ from the final figures.

This article summarizes analyses performed on one segment of the project--that relating to crops included in The Wheat Situation.

With the cooperation of members of the staff of the Agricultural Estimates Division of the Agricultural Marketing Service, estimates for acreage, production, and season average prices were compiled for rye, rice, winter wheat, durum wheat, other spring wheat, and all spring wheat. Season average prices for all wheat were used because no series of data for prices of the various types of wheat was long enough.

Data on Acreage and Production

The Crop Reporting Board first releases acreage data for most crops in March. The data are based on a survey of farmers' planting intentions as of March 1. Acreage estimates of fall-sown grains--winter wheat and rye--are released in December of the year preceding harvest. For some crops, these early-season estimates of acreage or intentions are the first indications of probable changes in production. For winter wheat, however, the initial forecast of production coincides with the release of the forecast on acreage; hence acreage estimates for this crop are not included in this study.

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[1] The research on which this article is based was carried on under authority of the Agricultural Marketing Act of 1946 (RMA, Title II). A summary of this article was published in the April issue of The Wheat Situation, WS-143.

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In the early years of crop reporting, acreage intentions were not reported in the same form as now. Since 1936, however, these figures for the crops covered by this article have been consistently reported on a planted acreage basis. To insure valid conclusions, analyses involving data on acreage intentions begin with 1936. For rye, early-season estimates of seeded acreage are available back to 1916.

The first forecast of the production of winter wheat is published about December 20 of the year before harvest. Thereafter the Crop Reporting Board makes forecasts of production of winter wheat from April through August. Monthly forecasts of production are made for rye from May through August; for all spring wheat, from June through October; for Durum and other spring wheat, from July to October; and for rice, from July to November. In each case, monthly forecasts are based on the condition of the crop on the first of the month, and assume average weather for the rest of the growing season. A preliminary estimate of production for the year is issued in December; a revised estimate is published in the annual summary report for the December following. A further revision, based on Census benchmark data published every 5 years, is made as soon as possible after these data become available. In this analysis, we refer to these estimates as "preliminary December," "revised December," and "final figures."

Data on Prices

Two sets of estimates of season average prices for the United States are published and successively revised. Essentially, these represent State estimates of the season average price received by farmers weighted by estimated quantities (1) produced and (2) sold to derive over-all prices for the country for the crop year. The estimates allow for loans unredeemed at the end of the crop marketing season and for quantities bought by the Government under purchase agreements if the volume is significant. The first estimate of the season average price weighted by production is published in December and revised the following December. 2/ In the May following harvest of the crop, an estimate of the season average price weighted by sales is published; this is revised a year later. Each of these series is again revised when Census data on production and sales become available. From time to time, longer term revisions are made. The research analyst has some interest in knowing the extent to which these several estimates are correlated and the extent to which they differ from a simple average of United States prices for the months involved in a particular marketing year. As for production, these successive estimates are referred to as "preliminary," "revised," and "final estimates."

2/ Beginning in 1955, a revision of this figure will be included in a footnote in the May report.

Periods covered in analyses of data on prices vary. Before 1935, prices published in the December report applied only to December 1. As a result, analyses based on these series begin with 1935. Cut-off points at 1938 and 1940 were necessary for the revised and preliminary price series issued in May because comparable data before these years were not available. For the remaining series, however, many more years of data were available.

Differences between Early-Season and Final Production Estimates

Results of the analyses on production are first presented in terms of the relative magnitude of the difference between early-season and final estimates by using standard deviations expressed in physical units. Standard deviations measure the scatter or dispersion about an average such that the average plus or minus one standard deviation will ordinarily include about two-thirds of the observations. Since the long-time average of the forecasts for any month is approximately the same as the average of the final estimates, the average difference between early-season and final estimates will approximate zero. In computing standard deviations, the square of the difference between each observation and its average is used, so that in effect the sign of the difference is ignored. For the kind of data used in this study, the size of the standard deviation directly indicates the relative size of the differences between the estimate of the crop and any given monthly forecast within the period under study.

Because of variations in weather conditions during the remainder of the season, the first forecast on the average varies most from the December estimate. Successive monthly forecasts tend to be closer to the December figure. For example, a forecast of the winter wheat crop in the December prior to harvest first was published in 1936. Based on data for 1936-53, the standard deviation of the difference between this forecast and the estimate of the size of the crop published in December following harvest is 131 million bushels. This means that roughly two-thirds of the differences between the early December forecast and the production estimate will equal or be less than 131 million bushels. For the April forecast, this figure drops to 85 million bushels. A decline to 70 million bushels takes place for the June forecast, with a drop to 14 million bushels in August. (See figure 1.)

A change in the method of obtaining reports from farmers occurred in 1924 when the rural mail carrier survey was initiated. 3/ As this survey was designed to improve the accuracy of the forecasts, certain

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3/ Rural mail carriers distribute about 600,000 unaddressed individual-farm questionnaire cards to farmers along their routes three times each year--in June and December for livestock and in October for crop acreages planted and harvested. About 160,000 cards or 27 percent are returned and tabulated.

analyses begin with 1925. Other periods were analyzed for specific crops whenever the month of publication of the initial forecast of production changed and it was felt that this might have a statistically significant effect on the analysis.

For winter wheat, 3 periods were analyzed--1912-53, 1925-53, and 1936-53. For the first and second periods, forecasts begin in May. For the last period, the first forecast is published in the December before harvest. Figure 1 indicates that the standard deviations for the 3 periods follow essentially the same pattern, suggesting that the past 18 years are long enough to give a reasonable estimate of the relative size of the differences for the early-season forecasts. The standard deviations shown in this chart are based on differences between the early forecast and the preliminary December estimate. Hence they drop to zero in December. As indicated in table 1, small adjustments in the estimates are made in the following December and again when Census data become available.

Figure 1 also shows the standard deviations of the year-to-year changes in production for the periods 1912-49, 1925-49, and 1936-49. These computations were based on the production estimates made after Census data became available. Standard deviations of the differences for early-season forecasts are smaller than the standard deviations of year-to-year changes in all months of forecast except the December prior to harvest. Standard deviations of year-to-year changes for the other crops are shown in the last line of table 1.

Table 1 shows standard deviations of the differences between specified forecasts and the preliminary December estimate for each of the crops included in this study for specified periods. Taking any period studied, the standard deviations for the successive monthly forecasts are largest in the early part of the crop year and then decline gradually to zero in December. For Durum and other spring wheat, the forecasts for August are much closer to the December estimate than those for July, and a further substantial improvement is found in the September forecast.

For rye and rice, the forecasts show a more gradual improvement from month to month. As for winter wheat, the rye forecasts by July are close to the preliminary December figure. For rice, the standard deviations of the differences through September are about as large as the standard deviation of the year-to-year changes, and they continue almost half as large through November.

Changes between the preliminary December estimate and the revised December estimate chiefly reflect information obtained on the volume of marketings. For all of the grains included in this study except rice, these changes are small relative to the year-to-year variation in production. For rice, however, the standard deviation of this difference was about 55 percent as large as the standard deviation of the year-to-year change. Further revisions are made after data from the quinquennial

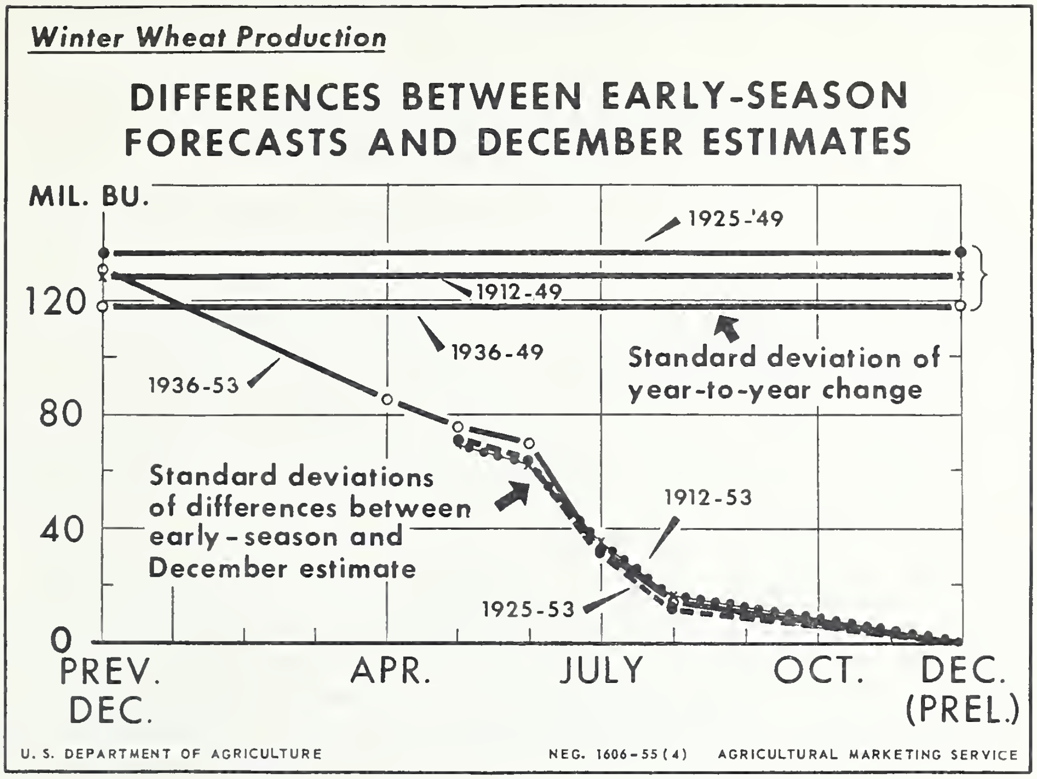

Figure 1

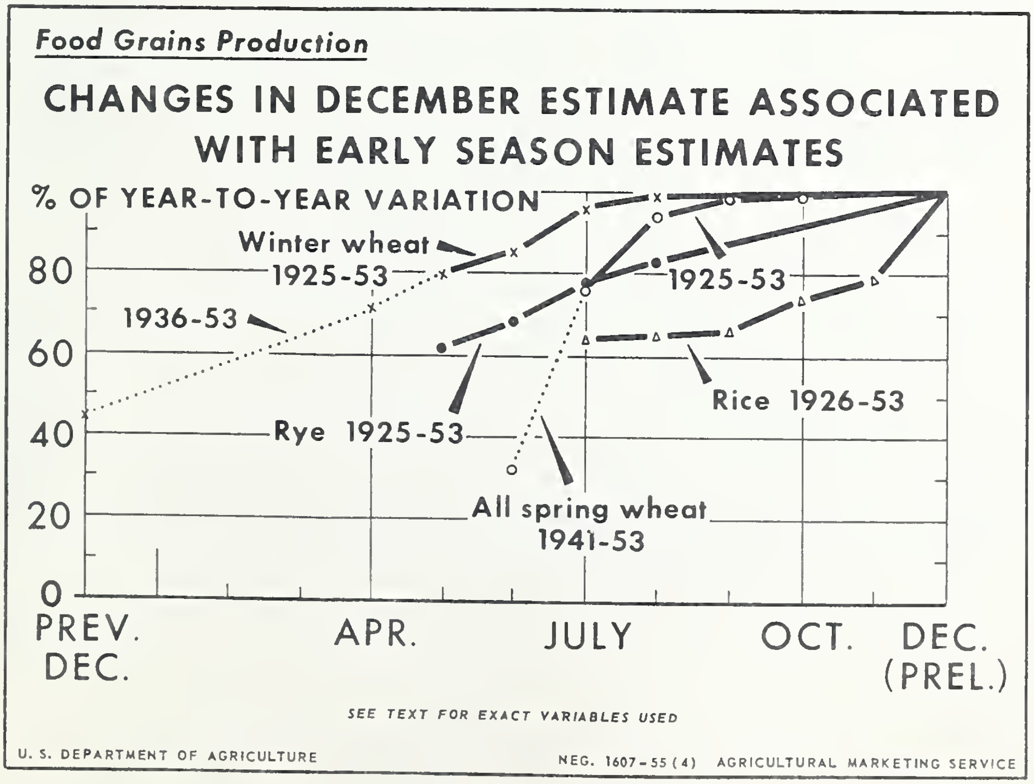

Figure 2

Censuses of Agriculture become available. These revisions are minor for wheat and rye but for rice amount to about 25 percent of the year-to-year changes in production.

Percentage of Year-to-Year Changes in Production Predicted by Early-Season Forecasts

Another way to study the usefulness of the early-season production forecasts in connection with price or utilization forecasts is in terms of the percentage of variation in year-to-year changes in production that could be forecast by making use of them. These analyses were made in the following way: (1) The forecast for a particular month was expressed as a change from the preliminary December estimate of the crop for the preceding year; this would be the best estimate available with respect to the size of that crop as of the date of the forecast. (2) The preliminary December estimate of the current crop was expressed as a change from the revised December figure for the preceding year, as these are the figures published in the December Crop Report. (3) A correlation analysis was run using the first change as the independent variable and the second change as the dependent variable. The square of the correlation coefficient, called the coefficient of determination, represents the percentage of variation in the dependent variable associated with variations in the independent variable. These percentages are shown in table 2 for the various periods used in the preceding analyses and are summarized in figure 2 for the various crops, using a consistent time period to the extent possible.

A somewhat different method is needed to evaluate the usefulness of the early-season forecasts of acreage as a predictor of production for months prior to the initial forecast of production. In the report for rye published in December before the year of harvest, only a figure on seeded acreage is given; in the March intentions report, only a figure for spring wheat and rice on intended acreage to be planted is available. The preliminary estimate of planted acreage for the preceding year as indicated in the December Crop Report was subtracted from the seeded or intended acreage. This was used as the independent variable in the analysis. Data on the seeded acreage of rye issued in December and on intentions to plant for the spring wheats issued in March show little effect in indicating probable production for the periods studied. But for rice, 57 percent of the year-to-year variation in production is associated with variations in the intended acreage. One problem in connection with the early-season forecasts of rye is that a substantial part of the acreage is not harvested for grain. The fact that little relationship was found on the average in the case of the spring wheats and rye does not, however, preclude the possibility that a significant effect on changes in production may result in years with unusually large changes in acreage.

The figures in table 2 move in the reverse direction of those on standard deviations as the dates of forecast approach that of harvest. Only 44 percent of the year-to-year variation of production of winter wheat can be forecast on the average by making use of the December forecast for the year preceding harvest; but this percentage increases to about 80 in May, to about 95 in July, and to over 99 in August. For the spring wheats, the forecasts from September on explain more than 95 percent of the year-to-year variation in production. For rye, the last forecast, issued in August, is associated with only about 85 percent of the year-to-year change in production, and the November forecast for rice is associated with only about 80 percent of the change in the production estimate. Percentage adjustments on the average after the preliminary December estimate have been less than 1 percent for all items except rice. For rice, variations in the preliminary December estimate are associated with about 84 percent of the year-to-year change in the revised figure, and variations in the revised figure are associated with about 96 percent of the year-to-year change in the final figure.

Frequently farmers and members of the trade are more interested in accurate estimates of the direction of change in production from one year to the next than in the magnitude of the change, although both are important in forecasting prices or other economic variables. It can be shown by mathematical statistics that the probability that the forecast will indicate the correct direction of change depends directly on the size of the correlations discussed in preceding paragraphs. Using these correlations for 1936-53 for winter wheat, we would expect the forecast to indicate the correct direction of change 73 percent of the time for the early December forecast, 85 percent for the May forecast, and 94 percent for the July forecast. For these years, the forecast indicated the same direction of change as the preliminary December estimate 61 percent of the time for the early December forecast, 78 percent for the May forecast, and 94 percent of the time in July. 4/ The formula used to derive the expected percentages involves a trigonometric function and hence is not given here. The same general relations would hold for other crops.

Regression Equations That Are Useful for Prediction

In the past, most analysts have used the production forecast as the best indication of the probable size of the crop. This procedure is valid only when the regression coefficient between the crop and the forecast, or between the change in the crop and the change in the forecast,

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4/ Actual percentages would be expected to differ from the estimated percentages for 2 reasons: (1) In deriving the mathematical probability a bivariate normal distribution was assumed, whereas the distribution is known to be skewed and (2) the formula calls for the value of the correlation for the entire population but a value based on our sample was of necessity used.

does not differ significantly from 1. Table 3 shows the regression constants for those analyses for which coefficients of determination, in percentage terms, are given in figure 2. Regression coefficients that do not differ significantly from 1, and constant values that do not differ significantly from zero, are indicated by an asterisk. Those analyses for which the coefficients have no asterisk would be expected to yield significantly better estimates of the crop than would a direct use of the forecast value.

For example, for the July forecast of rice production, the change in production on the average is equal to 1 million bags plus 69 percent of the indicated change in production from the preceding year. These coefficients differ significantly from 0 and 1, respectively. Thus, with forecast increases in production of 1, 2, and 4 million bags, respectively, use of the regression equation would suggest probable increases in actual production of 1.7, 2.4, and 3.8 million bags. Assuming a continuation of conditions that prevailed during the years included in the study, on the average, such estimates will be closer to the final figure than would the forecast values as such. Regression equations of this sort statistically take into account the extent to which weather conditions during the remainder of the season may deviate from normal, given the weather conditions to date at the time of forecast.

Percentage of Year-to-Year Changes in Prices Predicted by Earlier Estimates of Prices

In connection with the several available estimates of season average prices, the analyst is chiefly interested in the extent to which one series can be substituted for another as a measure of year-to-year change, as they are published at different times. Data that relate to this are shown in table 4. The first 3 lines show the percentage relationships between year-to-year changes in final estimates of season average prices weighted by production and simple averages for months in the marketing year. With the exception of spring wheats, year-to-year changes in simple averages are associated with not to exceed 95 percent of the year-to-year change in the weighted average. The rest of the lines in this table present percentage relationships between published weighted average prices and similar averages published at a later date. For example, an analyst might wish to know how well the price weighted by production issued in December would predict the price weighted by sales issued in the following May. This comparison is shown in line 5. When the preliminary figure weighted by sales is issued in May, the analyst might wish to know whether this would give a better estimate of the revised December figure weighted by production than would the preliminary December figure. These figures are shown in lines 6-8. For each of these items, the May figure would give a better estimate of the revised December figure than would the preliminary December figure. (Beginning in 1955, a revised price weighted by production is included in the report issued in May.) When the revised

December figure is issued, the analyst would have a choice of using this to estimate the revised May figure or of using the preliminary May figure. These figures are shown in the last 2 lines. Here the coefficients suggest that either approach would yield results of approximately equal accuracy. A comparison of the degree of correlation between the revised May and the revised December figure indicates the extent to which weighting by (1) production and (2) sales makes a difference in the end result. This comparison is shown in the next to last line. For the 3 commodities, the difference is negligible. The analysis between year-to-year changes in the final estimates of season average prices weighted by production and the revised December estimates indicates that negligible changes result when Census data are used for weighting purposes. This is shown in line 4 of the table.

Similar Research Relating to Other Commodities

This is the first of a series of articles that will be published or summarized in applicable Situation Reports during coming months giving information of this type. Analyses are currently underway for all of the crops included in the General Crop Report. When these studies are completed, we plan to study fruit crops not covered in the General Crop Report and truck crops, and then to consider related analyses for livestock and livestock products.

Table 1.--Production of food grains: Standard deviations of differences between December estimates and early-season forecasts and of year-to-year changes

Item and period	Wheat							Rye		Rice	
	Winter			All spring		Durum	Other spring				
	1912-53	1925-53	1936-53	1912-53	1925-53	1929-53	1929-53	1916-53	1925-53	1912-53	1926-53
	Mil. bu.	Mil. bu.	Mil. bu.	Mil. bu.	Mil. bu.	Mil. bu.	Mil. bu.	Mil. bu.	Mil. bu.	Mil. bu.	Mil. bu.
Difference between preliminary December estimate and forecast in -											
Preceding December	---	---	131	---	---	---	---	---	---	---	---
April	---	---	85	---	---	---	---	---	---	---	---
May	70	71	76	---	---	---	---	8	7	---	---
June	63	64	70	---	---	---	---	7	5	---	---
July	36	33	33	47	39	7	32	5	3	1.8	1.8
August	16	13	14	24	17	4	16	4	2	1.6	1.6
September	---	---	---	13	8	2	8	---	---	1.5	1.5
October	---	---	---	7	7	2	6	---	---	1.2	1.1
November	---	---	---	---	---	---	---	---	---	---	.8
Revised December estimate	9	8	6	6	5	1	4	3	1	.9	1.1
	1912-49	1925-49	1936-49	1912-49	1925-49	1929-49	1929-49	1916-49	1925-49	1912-49	1926-49
Difference between revised December and final estimate	17	16	12	8	4	1	3	3	2	.5	.5
Year-to-year change in final estimate	128	136	118	82	70	16	56	18	16	2.4	2.0

Table 2.- Production of food grains: Percentage of variation in year-to-year changes in specified estimates associated with specified early-season forecasts 1/

Item and period	Wheat								Rye		Rice	
	Winter			All spring			Durum	Other spring				
	1912-53	1925-53	1936-53	1912-53	1925-53	1941-53	1929-53	1929-53	1916-53	1925-53	1912-53	1926-53
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Change in preliminary December estimate associated with-												
Production forecast in preceding December	---	---	44	---	---	---	---	---	---	---	---	---
Acreage estimate in preceding December	---	---	---	---	---	---	---	---	27	10	---	---
Acreage intentions	---	---	---	---	2/1	---	2/8	2/3/	---	---	---	4/57
Production forecast in-												
April	---	---	71	---	---	---	---	---	---	---	---	---
May	78	80	80	---	---	---	---	---	68	62	---	---
June	84	85	85	---	---	32	---	---	72	68	---	---
July	94	96	96	69	76	67	76	79	80	78	70	64
August	99	99	99	92	94	86	93	93	85	83	74	65
September	---	---	---	97	98	96	98	98	---	---	74	66
October	---	---	---	99	99	97	98	99	---	---	79	74
November	---	---	---	---	---	---	---	---	---	---	---	78
Change in revised December estimate associated with preliminary estimate	99.6	99.7	99.8	99.5	99.4	98.9	99.5	99.5	98.3	99.2	88	84
	1912-49	1925-49	1936-49	1912-49	1925-49	1941-49	1925-49	1929-49	1916-49	1925-49	1912-49	1926-49
Change in final estimate associated with revised estimate	99.0	99.3	99.6	99.3	99.6	98.1	99.6	99.6	97.1	98.1	92	96

1/ See text for exact variables used.
2/ Period begins with 1936.
3/ Less than 0.5.
4/ Period begins with 1944.

Table 3.--Production of food grains: Relation of year-to-year changes in preliminary December estimate to specified variables, based on 1925-53 1/

Related variable	Simple regression coefficient 2/		Constant value (a) in regression equation 3/		Standard error of estimate	Coefficient of determination times 100 4/
	Coefficient	Standard error	Coefficient	Standard error		
			Mil. bu.	Mil. bu.	Mil. bu.	Percent
Change estimated from forecast published in -			Winter wheat			
Previous December 5/	0.65*	0.18	45*	29	122	44
April 5/	.89*	.14	38*	20	86	71
May	.92*	.09	32	13	70	80
June	.88*	.07	23	11	61	85
July	.96*	.04	9*	6	33	96
August	.96	.01	1*	2	12	99
			All Spring Wheat			
June 6/	.45	.20	6*	11	38	32
July	.74	.08	-1*	6	35	76
August	.91*	.04	7/*	3	18	94
September	.98*	.02	-2*	2	9	98
October	.99*	.02	-2*	1	8	99
			Rye			
May	1.20*	.18	-3*	2	9	62
June	1.05*	.14	-2*	2	9	68
July	.93*	.09	-2*	1	7	78
August	.96*	.08	-2*	1	6	83
			Rice 8/			
			Mil. bags	Mil. bags	Mil. bags	
July	.69	.10	1.0	.3	1.5	64
August	.74	.10	.8	.3	1.5	65
September	.69	.10	.8	.3	1.5	66
October	.77	.09	.7	.2	1.3	74
November	.85*	.09	.3*	.2	1.2	78

1/ See text for exact variables used. Asterisks indicate regression coefficients that do not differ significantly from 1 at the 5 percent probability level and constant values that do not differ significantly from zero.

2/ Factor by which related change is multiplied.

3/ Factor to be added to related change.

4/ Percentage of variation associated in the two series.

5/ Based on 1936-53.

6/ Based on 1941-53.

7/ Less than 0.5.

8/ Based on 1926-53.

Table 4.--Season average price for food grains: Percentage of variation in year-to-year changes associated with specified early estimates 1/

Item and period	Wheat					Rye	Rice
	Winter	Spring			All wheat		
		Durum	Other	All			
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Final figure weighted by production associated with -							
Simple average price:							
1910-53	---	---	---	---	87	92	96
1930-53	93		97	---	92	92	95
1931-53	---	98	---	---	---	---	---
Revised December estimate:							
1935-49	99.9	99.9	99.9	2/100	99.9	99.9	99.7
Preliminary May estimate associated with -							
Preliminary December estimate							
1940-53	---	---	---	---	96	96	99.3
Revised December estimate associated with -							
Preliminary May estimate,							
1940-53	---	---	---	---	99.3	99.3	98
Preliminary December estimate:							
1935-53	96	97	94	95	96	97	94
1940-52	94	98	92	94	95	97	95
Revised May estimate associated with -							
Revised December estimate,							
1940-52	---	---	---	---	99.9	99.9	99.9
Preliminary May estimate,							
1940-52	---	---	---	---	99.5	99.4	98

1/ See test for exact variables used.

2/ Based on 1937-49.